ENERGY STORAGE

A DISTRIBUTED ENERGY RESOURCE

IMRE GYUK, PROGRAM MANAGER
ENERGY STORAGE RESEARCH, DOE

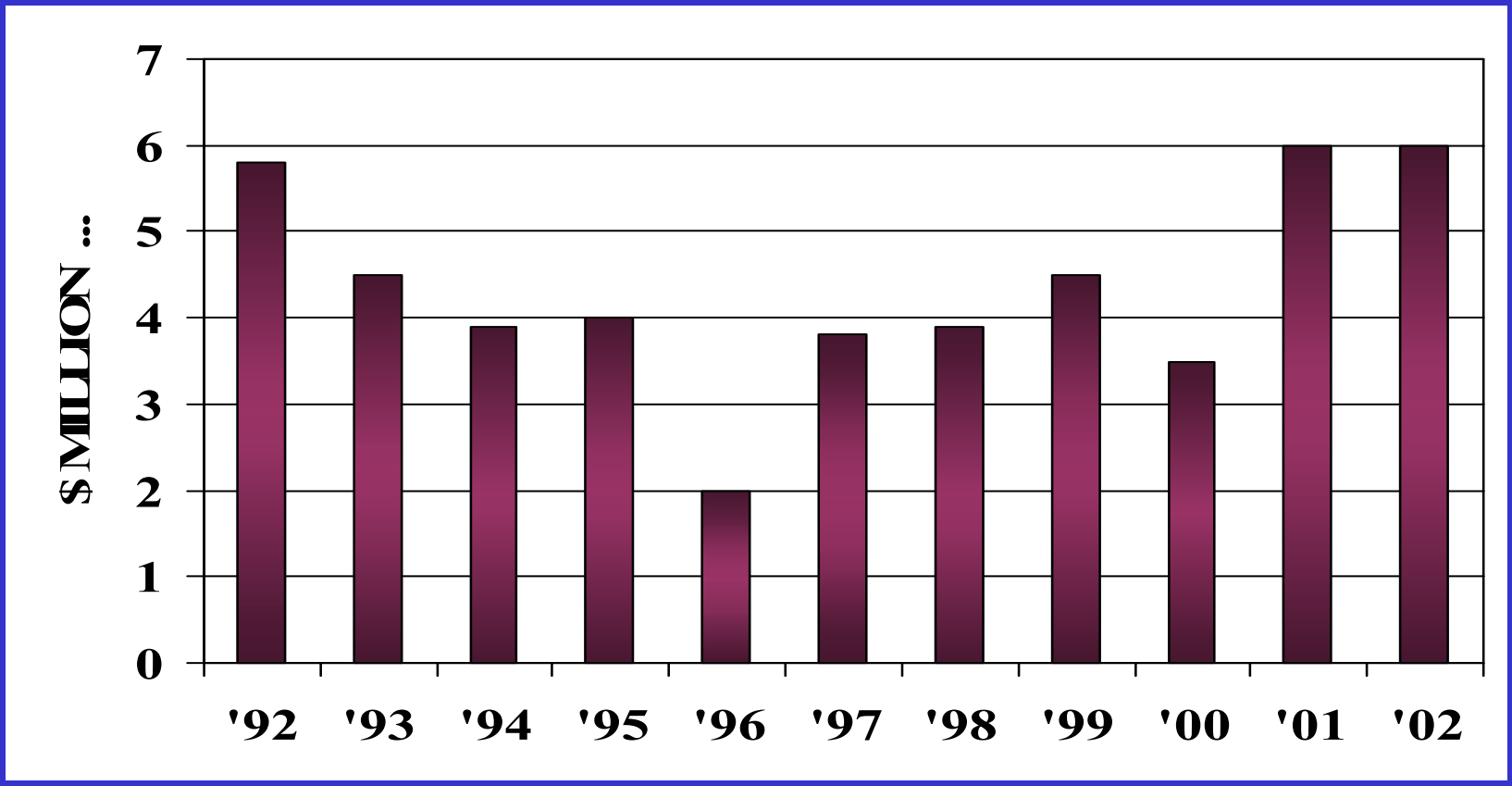
THE PROGRAM

ENERGY STORAGE SYSTEMS

RESEARCH PROGRAM

MANAGED THROUGH

SANDIA NATIONAL LABS.



APPROPRIATIONS / REQUEST

PROJECT MANAGEMENT:

PROJECTS COMPETED

COSTSHARED (ca. 50%)

FUNDED INCREMENTALLY

REGULAR FINANCIAL REPORTS

PROGRAM COMPONENTS:

SYSTEMS INTEGRATION (12)

SUBSYSTEM DEVELOPMENT (6)

STRATEGIC ANALYSIS (4)

ANNUAL PEER REVIEW:

- Open to Public
- International Panel of Reviewers
- Comments and Numerical Scores
- Published Proceedings

- Sep. 8 – 9, 1999, Arlington, VA
- Sep. 18 – 21, 2000, Orlando, FL
- Nov. 14 – 15, 2001, Crystal City, VA

INTERNATIONAL CONFERENCE:

Electrical Energy Storage Applications and Technologies

EESAT 2000: Sep. 18 – 21, 2000, Orlando, FL

EESAT 2002: Apr. 19 – 23, 2002, San Francisco, CA

CONTACTS & COLLABORATIONS A KEY TO SUCCESS:

ESA		IEA
TVA		BPA
VIRG. POWER	AEP	ARIZ. POWER
CEC		NYSERDA
EPRI		PEAC
ILZRO		EVAA

THE CONCEPT

ENERGY STORAGE

MEDIATES BETWEEN

VARIABLE SOURCES

AND VARIABLE LOADS

PROGRAM GOAL:

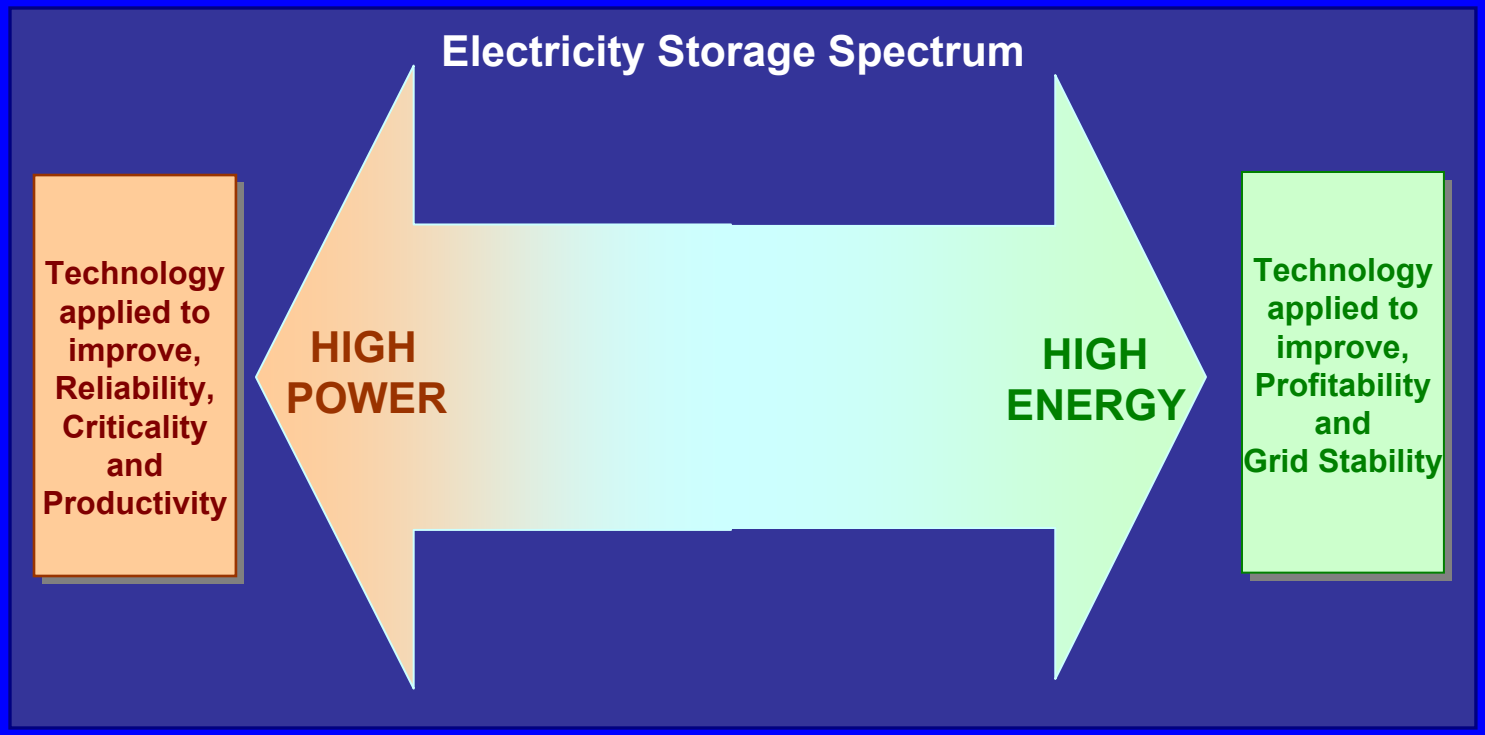
DEVELOP A BROAD PORTFOLIO OF STORAGE TECHNOLOGIES FOR A WIDE SPECTRUM OF APPLICATIONS

DEVELOP

SELF-CONTAINED SYSTEMS

WITH INTEGRATED

POWER ELECTRONICS



The Digital Economy

Restructured Energy Market

3 REGIMES OF STORAGE:

Power Quality (1cycle –15sec)

Load Following (mins.)

Energy Management (hours.)

POWER QUALITY:

DIGITAL EQUIPMENT WILL TRIP ON VOLTAGE SAGS OR SWELLS OF AS LITTLE AS 20% FOR A SINGLE CYCLE

PQ EVENTS ARE EXPENSIVE:

ESTIMATED YEARLY LOSSES

30 – 188 BILLION DOLLARS

EXAMPLE:

10 MW (LA BATTERY) SYSTEM

PROVIDES SEAMLESS POWER DURING OUTAGES

FOR A MICROCHIP PLANT

AFTER 15 SECONDS

A QUICK-START

GENSET TAKES OVER:

1-2 YEAR PAYBACK!!

10 MW - 15 sec System at Microchip Plant

SEAMLESS POWER CAN ONLY BE PROVIDED BY ENERGY STORAGE!

BUT FOR LONGER OUTAGES, DG PROVIDES NEEDED BACKUP

ENERGY STORAGE

AND DISTRIBUTED GENERATION

ARE COMPLEMENTARY!

LOAD FOLLOWING:

A) DISTRIBUTED GENERATION CANNOT RESPOND TO RAPID LOAD CHANGES

B) RENEWABLE GENERATION IS INTERMITTENT

EXAMPLE:

OILRIG AT DENVER AIRPORT POWERED BY

60kW MICRO-TURBINE TOGETHER WITH 100 kW ZnBr BATTERY

MICROTURBINE SATISFIES AVERAGE ENERGY DEMAND

PUMP NEEDS 150 kW TO DRAW OIL

AND - 80 kW FOR REGENERATIVE BREAKING

60 kW Micro-Turbine + 100 kW ZnBr Storage

EXAMPLE:

METLAKATLA, ALASKA

1MW / 1.4 MWhr (VRLA)

SUPPORTS

MINIGRID STABILITY

1 MW / 1.4 MWh Metlakatla Island

ENERGY MANAGEMENT:

A) LONG TERM STORAGE OF SIZABLE BLOCKS OF ENERGY TO BE DEPLOYED AT PERIODS OF GENERATION SHORTAGE OR TRANSMISSION CONGESTION

B) STORAGE OF BLOCKS OF RENEWABLE ENERGY TO MAKE IT DISPATCHABLE DURING PERIODS OF UNAVAILABILITY OR HIGH PRICES

EXAMPLE:

6 MW / 8hr

SODIUM SULFUR BATTERY

OHITO, JAPAN

6 MW / 8hrs Sodium-Sulfur

THE OPTIONS

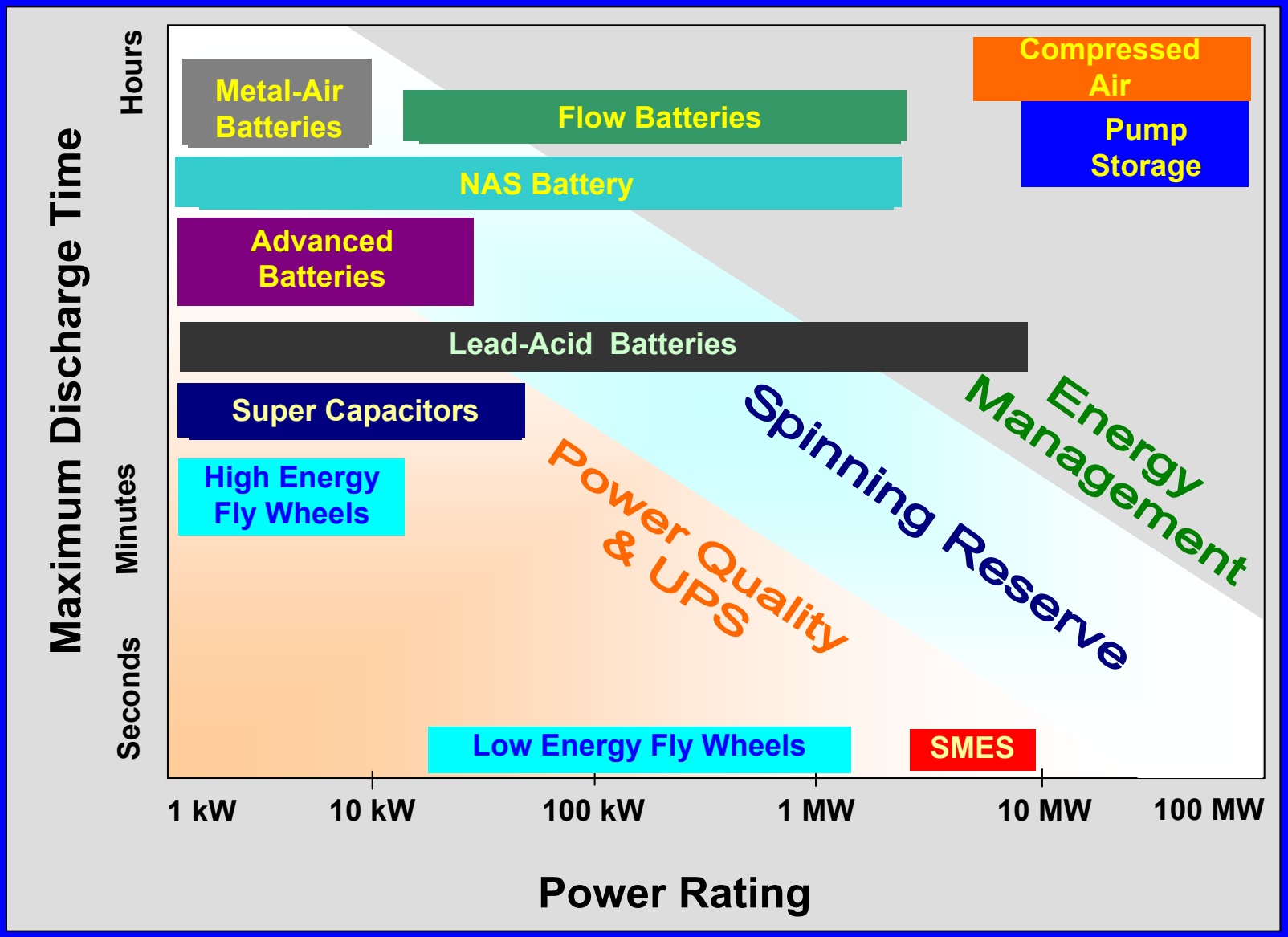
A PORTFOLIO OF OPTIONS:

Standards: LA, VRLA, NiCd

Flow Batteries: ZnBr, Regenesys

Advanced Batteries: Li-Ion, NaS

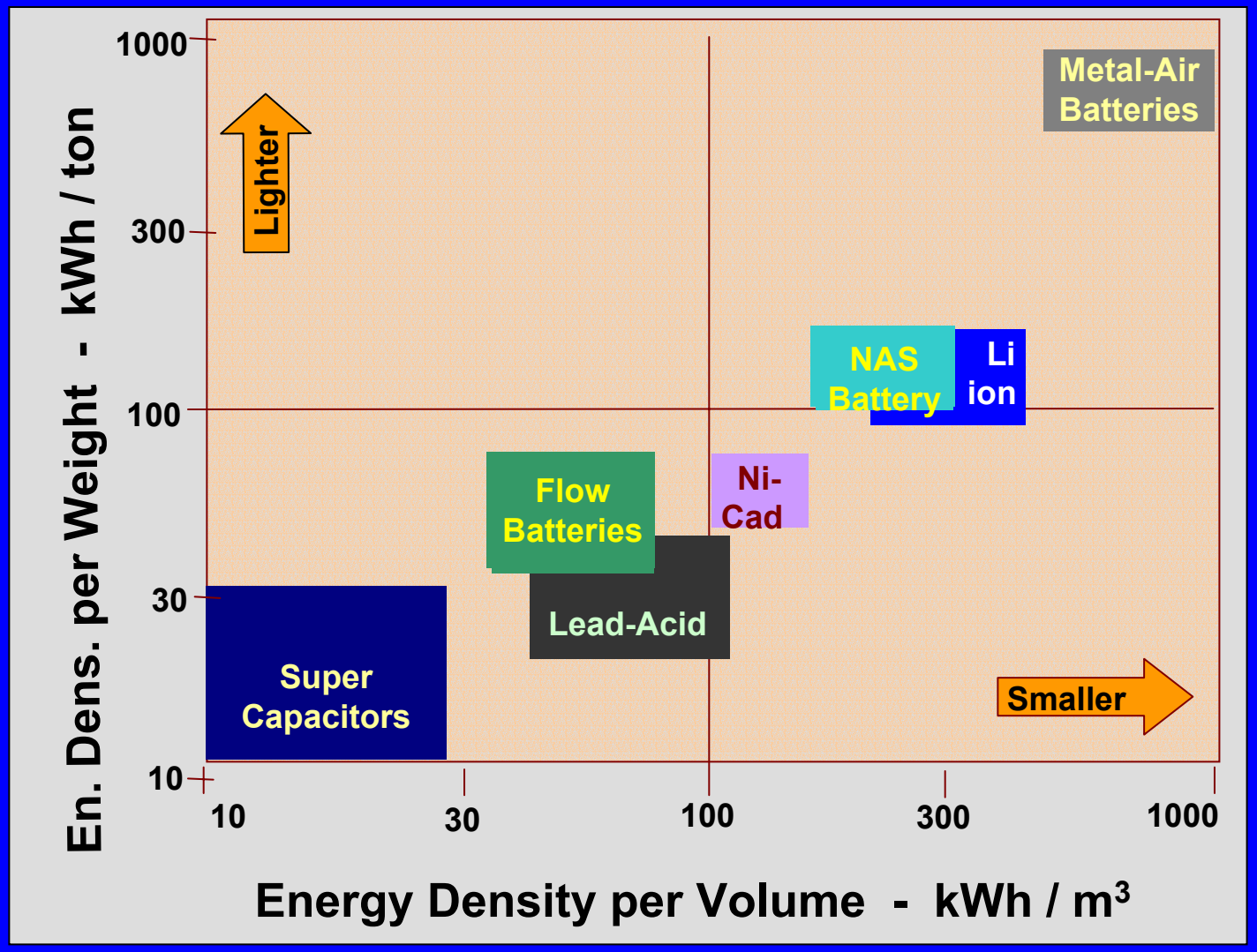
Flywheels, Supercaps, SMES


Maximum Discharge Time
Hours
Minutes
Seconds
Metal-Air Batteries
Flow Batteries
Compressed Air
Pump Storage
NAS Battery
Advanced Batteries
Lead-Acid Batteries
Super Capacitors
High Energy Fly Wheels
Energy Management
Spinning Reserve
Power Quality & UPS
Low Energy Fly Wheels
SMES
1 kW
10 kW
100 kW
1 MW
10 MW
100 MW
Power Rating

EACH TECHNOLOGY

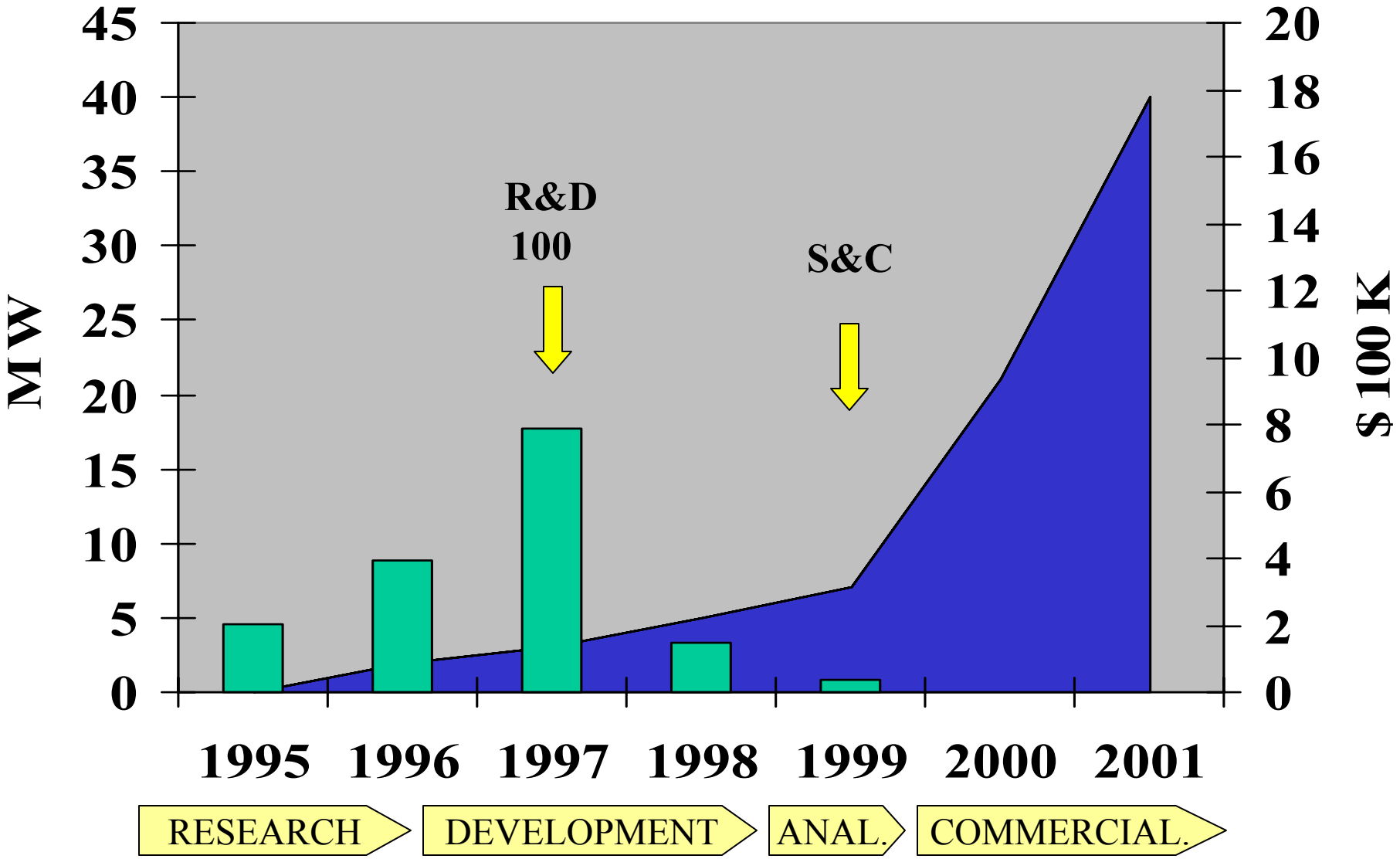
HAS UNIQUE ADVANTAGES

DIFFERENT RESEARCH GOALS


Metal-Air Batteries
Lighter
NAS Battery
Li ion
Flow Batteries
Ni-Cad
Lead-Acid
Super Capacitors
Smaller
1000
300
100
30
10
En. Dens. per Weight - kWh / ton
10
30
100
300
1000
Energy Density per Volume - kWh / m3

A PERFECT PROJECT

PQ 2000 POWER SYSTEM – FUNDING AND SALES



- $ 1.5 million in DOE funding
- $ 3.5 million in leveraged co-funding by industry
- A commercially successful system:

  40 MW in play with a market value of $ 15 million!

2 MW – 15sec Mobile Battery System